GR 99 P 2263

METHOD FOR ALLOCATING A TRANSMISSION CAPACITY TO CONNECTIONS IN A RADIO COMMUNICATION SYSTEM

Background of the Invention:

Field of the Invention:

The invention relates to a method for allocating a transmission capacity to connections in a radio communication system, particularly in a mobile radio system or wireless subscriber line system.

In a radio communication system, data, for example from a voice or multimedia service, is transmitted using electromagnetic waves. The electromagnetic waves are radiated at carrier frequencies included in the frequency band provided for the respective system. A radio communication interface is used to set up connections between at least one base transceiver station NB (Node B) and a plurality of subscriber stations UE (User Equipment), which may be mobile or stationary transceivers and are the bottommost elements in the system. A base transceiver station NB supplies radio-oriented resources to an area of up to several square kilometers in size, a so-called radio cell Z. The spatial limitation of radio cells allows reusing the limited resource of carrier frequencies simultaneously at a certain distance without the

radio channels interfering with one another. For this purpose, a plurality of radio cells Z form a cluster governed jointly by a radio network controller RNC, which is connected to an operation and maintenance center OMC. In turn, a plurality of radio network controllers RNC are connected by a mobile switching center MSC or a serving GPRS (General Packet Radio Services) service node (SGSN), which are used, inter alia, to access the analog and digital landline network PSTN (Public Switched Telephone Network), ISDN (Integrated Services Digital Network), a packet switching network, in particular an IP (Internet Protocol) network, or a further mobile radio network. Fig. 1 is a schematic illustration of such a cellular radio network.

In order to satisfy the available spectrum's demand for the scarce resource of "carrier frequencies" better, synchronous multiplex methods based on frequency-selective, time-selective and/or spreading-code-selective multiple access have been introduced to distribute the transmission capacity of a radio channel over a plurality of connections. These methods are accordingly called FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access). For this purpose, in consultation between the transmitter and the receiver with the inclusion of the base transceiver stations, a prescribed pattern or frame including transmission-synchronous and reception-synchronous

frequency bands, time slots and/or code sequences is used. The transmitters assign the data for the individual connections to this pattern or frame and the receivers separate the data intended for them from the received data stream. A disadvantage of this synchronous multiplex method is that the transmission capacity of such a circuit-switched or line-switched connection is fixedly prescribed by the multiplex frame or multiplex scheme, and transmission capacity cannot be released for other radio transmissions even if no transmission capacity is currently required.

A further basic method is packet switching. This method is based on the joint use of a radio channel having a high transmission capacity by a plurality of different connections. For this method too, the radio channel is subdivided on the time axis, although not into fixed time slots, but rather into addressed data packets of variable length. The data is transmitted in a time-variant manner, which is why the method could also be called an asynchronous multiplex method. Any transmitter can access the hitherto unused transmission capacity at any time and transmit its data, for example using a stochastic access method. In addition, the data rate of a bearer is very easy to vary smoothly. The transmitter can influence the data rate both through the use of the time intervals at which it sends the data packets, and also through the use of the length thereof.

Future mobile radio systems, such as the UMTS (Universal Mobile Telecommunication System), will offer radio subscribers a multiplicity of different services at different data rates. In addition to pure voice transmission, multimedia applications with the associated diversity of services will make up a large part of the data volume. Packet data transmission on the radio communication interface is particularly promising in this area.

For two-way message transmission in the uplink direction and in the downlink direction, the UMTS radio communication system is provided with both the so-called TDD mode (TDD = time division duplex), a combination of a wideband TDMA/FDMA (Time Division Multiple Access/ Frequency Division Multiple Access) system with a CDMA (Code Division Multiple Access) system, and the FDD mode (FDD = frequency division duplex), a wideband CDMA system (W-CDMA). The two modes promise a high degree of flexibility and efficiency for different data rates and demands on quality of service (QoS). This is achieved, in particular, by the Code Division Multiple Access method (CDMA), in which each carrier uses a different combination of short and long code sequences for transmitting messages between radio stations. The receiver restores an individual carrier by correlating the received data stream with the appropriate short and long code sequences. This access method

provides very flexible allocation of radio channel resources, because it supports carriers with different peak values for the data rate and carriers with variable data rates.

Summary of the Invention:

It is accordingly an object of the invention to provide a method for allocating a transmission capacity to a connection in a radio communication system which overcomes the above-mentioned disadvantages of the heretofore-known methods of this general type and which allows an efficient use of the available transmission capacity as a result of an improved allocation of the transmission capacity to the connections.

With the foregoing and other objects in view there is provided, in accordance with the invention, a method for allocating a transmission capacity to connections in a radio communication system, the method includes:

allocating a transmission rate to a connection established via a radio communication interface between a base transceiver station and a subscriber station in dependence of a connection-specific path loss of the radio communication interface.

In other word, according to the invention, a connection between a base transceiver station and a subscriber station is

allocated a transmission rate for signal transmission in the downlink direction from the base transceiver station to the subscriber station on the basis of a connection-specific level of path loss.

In accordance with another mode of the invention, the transmission rate is allocated on the basis of a distance between the subscriber station and the base transceiver station.

In accordance with yet another mode of the invention, the transmission rate is allocated on the basis of an interference situation at the location of the subscriber station in a radio cell of the base transceiver station.

In accordance with a further mode of the invention, at least one service to be transmitted on the connection can be transmitted at a variable transmission rate.

In accordance with yet a further mode of the invention, the service to be transmitted is a non-real-time service and/or is a real-time service, with adaptive source coding being carried out for the case of a real-time service.

In accordance with another mode of the invention, a particular transmission rate is allocated for a respective spectrum of path loss levels.

In accordance with yet another mode of the invention, the transmission rate is additionally varied on the basis of a relative or absolute transmitter power for the connection.

In accordance with a further mode of the invention, the transmission rate is additionally varied on the basis of a present level of traffic loading in the radio cell of the base transceiver station.

In accordance with yet a further mode of the invention, the transmission rate in the downlink direction from the base transceiver station to the subscriber station and/or in the uplink direction from the subscriber station to the base transceiver station is varied on the basis of the respective level of path loss.

In accordance with another mode of the invention, a subscriber separation is carried out in the radio communication system by using a CDMA method.

In accordance with yet another mode of the invention, orthogonal spreading codes are used in the downlink direction and/or in the uplink direction.

In accordance with another mode of the invention, the connection has a set of transmission rates made available to it, the respective transmission rate allocated being defined by a spreading code and a particular spreading factor.

In accordance with a further mode of the invention, a long-term transmission rate allocation based on path loss and/or on transmitter power is carried out by a Radio Resource Control layer (RRC layer) of the radio communication system.

In accordance with yet a further mode of the invention, the transmission rate is varied by using a Transport Format Set configuration/reconfiguration procedure in the RRC layer.

In accordance with another mode of the invention, the transmission rate is varied using a Transport Format Set restriction procedure of the RRC layer.

In accordance with yet another mode of the invention, the transmission rate is allocated by a utilization-level and connection-acceptance control or checking function in the RRC layer.

In accordance with a further mode of the invention, a Media Access Control layer (MAC layer) selects a suitable transport format from a set of different transport formats which is defined when a connection is set up.

In accordance with another mode of the invention, the MAC layer selects a suitable transport format from the set of transport formats in a soft handover situation, taking into account all possible signal paths.

In accordance with yet another mode of the invention, an allocation of the transmission rate is based on path loss measurements carried out by the subscriber station for handover purposes.

In accordance with a further mode of the invention, a variation in the current transmission rate is initiated by an overload control or checking function on the basis of path loss measurements in the subscriber station.

In accordance with yet a further mode of the invention, the transmitter power for a respective carrier of the base transceiver station is signaled to a radio network controller via an Iub interface.

In accordance with another mode of the invention, the signaling takes place as a result of an appropriate field being added within the Iub/Iur user frame protocol.

In accordance with yet another mode of the invention, the signaling takes place using independent periodic or event-controlled signaling messages.

In accordance with a further mode of the invention, the transmission rate is additionally allocated for a shared channel in the downlink direction on the basis of a transmitter power.

In accordance with yet a further mode of the invention, a joint detection method is carried out at the reception end in the downlink direction and/or in the uplink direction.

In accordance with another mode of the invention, the radio communication interface is organized on the basis of a TDD method which uses a plurality of time slots, which form a respective time frame. The transmission in the downlink direction and in the uplink direction takes place at separate times in the same frequency band.

In accordance with yet another mode of the invention, the radio communication system is in the form of a mobile radio system or is in the form of a wireless subscriber line system.

With the objects of the invention in view there is also provided, a radio communication system, including:

a subscriber station; and

a base transceiver station having a radio connection to the subscriber station, the radio connection having a given path loss and having an allocated transmission rate based on the given path loss.

In other words, a radio communication system according to the invention has at least one base transceiver station and at least one subscriber station for carrying out the method according to the invention as defined above.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Exemplary embodiments of the invention are explained in more detail with reference to the figures and on the basis of the document 3GPP, TSG RAN WG 2 "Radio Interface Protocol Architecture", TS RAN S2.01 v0.1.0, February 1999.

Although the invention is illustrated and described herein as embodied in a method for allocating a transmission capacity to connections in a radio communication system, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 is a schematic block diagram illustrating a radio communication system, in particular a mobile radio system;

Fig. 2 is a schematic block diagram illustrating an exemplary configuration of two subscriber stations within a radio cell of a base transceiver station; and

Fig. 3 is a comparison chart for comparing three strategies for allocating transmission rates to connections.

<u>Description of the Preferred Embodiments</u>:

Referring now to the figures of the drawings in detail and first, particularly, to Fig. 2 thereof, there is shown an exemplary configuration in which a first subscriber station UE1 is situated at a long distance from a base transceiver station NB, or close to the radio cell border, and a second subscriber station UE2 is situated close to the base transceiver station NB. First, just the case of signal transmission in the downlink direction DL is considered. In addition, it is assumed that the radio communication system supports a CDMA subscriber separation method, with orthogonal CDMA codes being used in the downlink direction.

As the following description discloses, the method according to the invention takes into account the special property of a radio transmission, namely that the necessary transmitter power P1, P2 rises with the level of path attenuation or path loss PL1, PL2 between the base transceiver station NB and the respective subscriber station UE1, UE2. Since the system capacity of the radio communication system is predominantly restricted or limited by interference effects, the second subscriber station UE2 requires, with a low level of path loss PL2, only a relatively small proportion of the total transmitter power for the downlink DL and a small proportion of the resources available on the radio communication interface, irrespective of the real transmission rate.

The interference is given or defined by the total transmitter power at the location of the base transceiver station NB. The interference at the location of the first subscriber station UE1 on the border of the radio cell Z is primarily given by receiver noise No and intercell interference Iinter,1 caused by base transceiver stations NB in neighboring radio cells Z, whereas the interference at the location of the second subscriber station UE2 close to the base transceiver station NB is primarily given or produced by intracell interference caused by other subscriber stations UE in the same radio cell Z, and only a small proportion of it is produced by intercell interference Iinter,2.

The transmitter power P2 for signal transmission to the second subscriber station UE2 close to the base transceiver station NB thus contributes only to a very small extent to the total interference within the radio cell Z.

For the configuration described, a signal/interference ratio SIR1, SIR2 for the two subscriber stations UE1, UE2 and also a ratio of the transmitter powers P1, P2 are ascertained below.

In addition to the described parameters transmitter power P1, P2, intercell interference Iinter,1, Iinter,2 and receiver noise No, a processing gain PG1, PG2, which is attained by

despreading and decoding the received signal, and an orthogonality factor OF1, OF2, which describes the suppression of the intercell interference due to the use of orthogonal spreading codes, are considered. The processing gain PG1, PG2 is defined as the respective ratio between the chip rate and the net data rate for the respective carrier. The orthogonality factor OF1, OF2 is dependent on signal delay differences or propagation time differences and is accordingly lower for the second subscriber station UE2 close to the base transceiver station NB.

Assuming that PL1 >> PL2, and hence P1 >> P2, the signal/interference ratio SIR1 for the first subscriber station UE1 can be ascertained as follows:

$$SIR1 \approx \frac{PG1 \cdot P1/PL1}{No + Iinter,1} \qquad (1)$$

Disregarding or neglecting the receiver noise No and the intercell interference Iinter,2, the signal/interference ratio SIR2 for the second subscriber station UE2 can be ascertained as follows:

$$SIR2 \approx \frac{PG2 \cdot P2/PL2}{OF2 \cdot P1/PL2} = \frac{PG2 \cdot P2}{OF2 \cdot P1} \qquad (2)$$

Hence, (2) provides the ratio between the transmitter powers:

$$\frac{P2}{P1} = \frac{SIR2}{PG2} \cdot OF2 \qquad (3)$$

With an exemplary processing gain of 512 for a voice connection, a signal/interference ratio of 4 and 6 dB, respectively, and an orthogonality factor of 0.1, the ratio obtained for the transmitter powers is 1/1280. This proves that the second subscriber station UE2 contributes only marginally to the total transmitter power in the downlink direction DL, and hence also causes only a very low level of interference in the radio cell Z.

Consideration of this finding allows the transmission resources to be used more effectively according to the invention. Thus, for example, the transmitter power P2 or the signal/noise ratio for the connection to the second subscriber station UE2 can be increased to improve transmission quality, without any negative effects on the interference in the downlink DL. In addition, by way of example, the transmission rate for the connection to the second subscriber stations UE2 can be increased without any rise in the effective level of the system load. This method can be used advantageously for non-real-time services which can adaptively match their transmission rate to the particular resources currently

available. In the same way, the method can be used for real-time services such as voice transmission, for example if so-called adaptive multirate coding (AMR) is supported. In the case of a high level of system loading or in the case of blocking - for example if the necessary transmitter power exceeds the maximum transmitter power of the base transceiver station NB - the requirements for services with a high path loss can be reduced. This may be done, for example, by reducing the data rate or the desired signal/interference ratio.

Increasing the transmission capacity for the downlink direction DL is of particular significance because many data services, for example from database providers, have highly asymmetrical requirements, that is to say the volume of data, and hence the level of traffic loading, in the downlink direction DL is much higher than the level of traffic loading in the uplink direction UL. An improved throughput in the downlink direction DL is therefore equivalent to a larger number of carriers which can be provided within the radio cell Z, which increases the effective transmission capacity.

Various strategies can be used to allocate a transmission rate B to a connection.

According to a first known strategy, all carriers are allocated an identical transmission rate B, irrespective of the effective level of path loss. In this context, all carriers have identical characteristic features, such as the signal/interference ratio SIR and the processing gain PG. This allocation results, on the one hand, in an asymmetrical distribution of transmitter powers, but, on the other hand, results in a constant transmission rate B and quality of service QoS for all subscribers.

According to a second strategy for allocating transmission rates B to carriers, the different level of path loss PL for the respective subscriber stations UE is taken into account. A connection having a lower level of path loss PL can be allocated a higher transmission rate B, for example. This results in less variation in the transmitter power for the individual connections, and, as described above, in an optimized use of the available resources. This method can be used for connections in which the transmission rate for at least one service can vary.

The general functional correlation that the transmission rate B is a function of the respective level of path loss PL can be used to define the transmission rate Bi of a carrier i as being a function of the respective level of path loss PLi in the downlink direction DL. In this case, by way of example,

the current level of path loss can be compared with a threshold value PLthreshold, wherein a respective spectrum of path loss levels corresponds to a particular transmission rate. The respective transmission rate Bi for the carrier i is thus ascertained by multiplying a base transmission rate B by a factor n for a respective spectrum of path loss levels:

$$Bi=n\cdot B \quad \text{for } PLthreshold,n \geq PLi > PLthreshold,n+1 \qquad (4)$$

For a wideband CDMA system, it is also possible, by way of example, to provide for the transmission rate Bi of the respective carrier i to be doubled in each case on the basis of the following equation:

$$Bi=2^{(n-1)}\cdot B \quad \text{for } PLthreshold,n \geq PLi > PLthreshold,n+1 \qquad (5)$$

According to a further alternative strategy for allocating transmission rates to carriers, the relative or absolute transmitter power Pi required for a respective carrier i is taken into consideration. In this context, the relative transmitter power Pi is the ratio of the transmitter power Pi to the total transmitter power of the base transceiver station NB. The transmission rate Bi of the carrier i is therefore a function of this ratio.

The following numerical example reveals how the total transmission rate in kbit/s in a radio cell Z can be increased when using the invention's second strategy described for allocating transmission rates to connections, as compared with the first strategy with an identical transmission rate for all connections. Furthermore, the result of a third strategy is shown, in which the transmission rate for a connection is selected randomly and irrespective of any path loss.

In the exemplary calculation, the following requirements for the radio communication interface are assumed:

Environment	Living area, residential district
Mobility	Pedestrian
Radio cell	Microcell

In addition, the following system parameters are taken as a basis for these requirements:

Number of carriers	40
SIR	4 (6 dB)
Base transmission rate B	8 kbit/s
Processing gain PG	512
Orthogonality factor	0.06
Standard deviation of log normal distributed fading	10 dB

Interference coupling	2
Basic path loss PL	127 dB
Radio cell radius	300 m
Receiver noise No	-102 dBm

In addition, it is assumed that the subscriber stations are distributed evenly in the radio cell - the probability that a subscriber station-is at a particular distance or range rises linearly with the distance.

The respective result of the three allocation strategies is disclosed in the table shown in Fig. 3.

For the result for strategy 2, that is to say the allocation of transmission rates on the basis of the respective level of path loss, a transmission rate of 8 kbit/s has been selected for a level of path loss PL >120 dB, whereas a transmission rate of 16 kbit/s has been selected for a level of path loss ≤120 dB. For strategy 3, the number of subscribers per transmission rate is equivalent to the respective number for strategy 2.

The results clearly reveal that the total transmission rate in kbit/s has increased with strategy 2, with the total transmitter power having increased only marginally. To achieve

the same total transmission rate, a much higher total transmitter power is necessary for the third strategy.

In the case of the result for strategy 2 it should be taken into account that, with respect to an allocation that is dependent on path loss, an increase in the transmission rate to 16 kbit/s requires a corresponding increase in the transmitter power by approximately 3 dB, whereas the demands on the transmitter power for the lower transmission rate of 8 kbit/s are virtually identical. This means that the individual transmitter powers are assimilated or become similar when the total transmitter power is increased only marginally.

The following text describes an exemplary network-side implementation of the method according to the invention. The basis used for this is the layer structure and protocol structure of the third generation UMTS mobile radio system, in accordance with the aforementioned document "Radio Interface Protocol Architecture".

The method can be implemented in two different ways, with a distinction being drawn between long-term resource allocation and short-term resource allocation.

The exemplary implementations described are based on a control of the allocation of transmission rates to connections for signal transmission in the downlink direction DL, wherein the use of orthogonal spreading codes is assumed for the downlink direction. The use of orthogonal spreading codes or alternatively a reception-end joint detection method causes the intracell interference to be suppressed, which means that the total transmission capacity is primarily dependent on the intercell interference. As a general rule, it is possible to stipulate that a subscriber station whose interference situation is predominantly determined by intercell interference ought to be allocated a relatively low transmission rate, whereas a subscriber station whose interference situation is predominantly determined by intracell interference ought to be allocated a higher transmission rate.

The method may be implemented for the case of long-term resource allocation, for example within the Radio Resource Control (RRC) function. According to the ISO (International Organization for Standardization) OSI (Open Systems Interconnection) layer model, which was created for an extensive standardization of communication systems, the RRC function is a Layer 3 function.

When a connection is set up, a so-called set of transmission formats ("Transport Format Set") is defined for each carrier on the basis of an available bandwidth and QoS demands, the set of transmission formats containing a set of different transmission rates and a respective reservation for a code with a corresponding spreading factor. This function provides long-term resource allocation for the requested radio channel resources and can take into account a so-called statistical multiplex advantage, resulting from a reciprocal or mutual compensation for the transmission rate demand of carriers with a variable bit rate.

The RRC layer receives path loss measurements from various subscriber stations and controls the transmission rate of particular selected subscriber stations using the signaling procedure within the RRC layer. Here, for example, the following two procedures can be used for matching the transmission rates of the particular carriers to the currently available transmission capacities.

A Transport Format Set reconfiguration procedure can be used to vary the transmission rate. This is initiated by the utilization-level and connection-acceptance function and can be based on path loss measurements carried out by the respective subscriber station, for example for handover purposes. In this context, both the level of path loss for the

dedicated base transceiver station and the level of path loss for neighboring base transceiver stations can be involved in the allocation.

A further significant RRC signal procedure is the transport format restriction, which can be used for reducing the current transmission rate. Transmission rate restriction for non-real-time services with a high level of path loss is an efficient measure of reducing the intensity, frequency of occurrence and duration of an overload situation. This signaling procedure is requested by the overload checking function and can in turn be based on the path loss measurements of the subscriber stations. In general terms, it is practical to reduce only the transmission rates of one or more connections with a high level of path loss or a high transmitter power, rather than to reduce the transmission rates of all connections equally, irrespective of individual path loss levels or transmitter powers.

A second exemplary possibility for implementing the method can take place within the Media Access Control (MAC) layer for the purpose of so-called short-term resource allocation (packet scheduling). According to the ISO OSI layer model, the MAC function is assigned to Layer 2.

The MAC layer is responsible for the use of the various physical traffic channels (TCH). The MAC layer selects a particular transport format, essentially a particular transmission rate, from the set of transport formats defined during connection setup, as described. To ensure suitable or prioritized distribution of the available bandwidth in dependence of the present requirements of the various carriers, appropriate package scheduling algorithms can be used.

The transmission rate allocation based on the transmitter power requires the absolute or relative transmitter power for each carrier of a base transceiver station to be signaled to the radio network controller RNC via the Iub interface, as is shown in Fig. 1. This can be achieved, for example, by adding an appropriate field within the frame protocol defined on the Iub interface for transmitting transport blocks between the base transceiver station and the radio network controller. Another possibility is the use of independent signaling messages transmitted from a base transceiver station to the radio network controller, either cyclically or under event control. In this case, it is possible to use the proposed strategy for allocating the transmission rates within the Media Access Control layer. The MAC layer selects a suitable transport format, in particular a specific transmission rate, from the set of transport formats. As a general practice, the

MAC facility, which is responsible for selection of the transport format on dedicated channels, takes into account merely the buffer status of the corresponding subscriber stations when making scheduling decisions. Additional consideration of the path loss or consideration of the transmitter power and of the buffer status of the connected carriers offer great potential for optimizing the total system throughput and for providing a suitable or fair distribution of the transmitter power in the downlink, which is the real transmission resource in a radio system using a CDMA method.

If, by way of example, a connection is in a so-called soft handover state, i.e. if signal transmission in the downlink is taking place in parallel in a plurality of radio cells, all the possible propagation paths for the signals need to be taken into account when allocating the transmission rate. This can be done, for example, by selecting the transmission rate such that it causes no impairment of the total transmission capacity of the system on any of the transmission paths - selection of the minimum transmission rate.

If the transmitter power is signaled to the radio network controller via the Iub interface, a power-based bit rate allocation can also be used on a so-called shared channel. Such a shared channel is for example proposed for the future UMTS mobile radio system. With this type of transport channel,

bandwidth allocation and packet scheduling are carried out by the MAC layer in each case. These allocation and scheduling decisions should again be based on the required resources (buffer status of the various carriers) and the available resources (transmitter power or level of path loss) in this case too, in order to optimize the possible data throughput.

The implementations described can be used for different types of service.

Reduction of the transmission rate is primarily useful for non-real-time services, since, with these services, the data packets can be buffered if the transmission rate is lower than the reception rate for new data packets.

It is also possible to use the allocation strategy according to the invention for real-time services with an adaptive source rate. However, this requires the source coder to be controlled or checked through the use of explicit signaling messages transmitted by the radio system to the transcoding unit. This method can be used for adaptive voice codecs, which are the standard codecs in the UMTS mobile radio system. The transmission rate of the codecs is then selected on the basis of the respective level of path loss or the transmitter power of the corresponding carriers.

The method described for transmission rate allocation supports further applications which may be significant for the future UMTS mobile radio system. This method can be used generally, because intercell interference and intracell interference is always dependent on the level of path loss for the various connections. This means that each subscriber station whose interference situation is primarily dominated by intercell interference (and which itself causes intercell interference to a large degree) should receive or, respectively, transmit at a relatively low transmission rate, whereas a subscriber station which primarily experiences and generates intracell interference should receive or, respectively, transmit at a higher transmission rate. For this reason, the method according to the invention has a significantly broader scope of use than described above. This will be explained using the examples below.

The method proposed can likewise be used for signal transmission in the uplink direction. This means that the total system throughput can be increased by allocating a relatively high transmission rate to the subscriber stations with a low level of path loss to the respective base transceiver station whose radio coverage range includes the subscriber station. By way of example, this procedure affords an increase in the transmission capacity for a wideband CDMA system operated in the FDD mode.

This situation is improved further if, corresponding to the transmission in the downlink direction, orthogonal spreading codes are also used in the uplink direction, or a joint detection method is carried out in the base transceiver station. These options advantageously allow any intracell interference arising to be effectively suppressed. In this case, the system capacity in the uplink is primarily restricted by intercell interference. Intercell interference can be reduced if the transmission rate of subscriber stations at the edge of the radio cell is reduced and the transmission rate of subscriber stations with a low level of path loss is increased. Here, the transmitter power is a measure of the extent of intercell interference produced by a subscriber station. The same implementation options can be used as explained above for the downlink direction.

The method described can be used in the same way in other radio communication systems using a CDMA method. Examples are:

- TDD mode in the UMTS mobile radio system,
- Direct sequence CDMA,
- Frequency hopping CDMA,
- Time hopping CDMA.